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ABSTRACT

A field experiment is described on the use of computer-related instruction at the college level in political science. The program modules are designed to: (1) teach a substantive body of knowledge in an introductory American government course; (2) introduce students to the basic methods of data analysis; and (3) teach elementary techniques of computer use. The substantive material and the basic concepts of data analysis were presented to a second introductory American government course in lecture format. The control group was not a course normally taught by the experimenter. Significant student achievement in methodology and computer concepts were found with the computer-developed modules. It was found that computer-related instructed students did no worse than lecture-taught students in voting behavior topics. The document concludes with a discussion of the implications of the research for higher education. (Author/JR)

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ACHIEVEMENT AND ATTITUDE WITH COMPUTER RELATED INSTRUCTION: A FIELD EXPERIMENT

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ABSTRACT

Achievement and Attitude with Computer Related Instruction:

A Field Experiment

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This paper is a field experiment on the use of computer related instruction. Students at State University of New York at Geneseo were tested on their achievement in voting behavior, methodology, and computer techniques before and after use of a computer related instruction module. The author finds significant student achievement in methodology and computer concepts with the use of the APSA-ICPR developed modules known as SETUPS. Computer related instructed students did no worse than lecture taught students in voting behavior topics. The implications of the research for higher education are also discussed.

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ACHIEVEMENT AND ATTITUDE WITH COMPUTER RELATED INSTRUCTION: A FIELD EXPERIMENT*

> "...the people instrumental in developing the Computer Related Instruction materials often profit more from the experience than the students using them."
>
> --Robert A. Seltzer
> Educational Technology, 1974

A survey of most journals in Political Science would indicate that research undertaken by scholars in recent years has become more quantitatively oriented. The inevitable consequence of this emphasis is reflected in teaching undergraduate political science courses. Indeed most introductory political science texts require a basic skill in the comprehension of graphs, tables, and figures which present quantitative data. For example, a widely used textbook in American Government has 55 tables and figures which require the student to analyze quantitative data. (Irish and Prothro, 1971). Furthermore many of the basic concepts in the discipline of political science require at least a basic understanding of data analysis.

Increasingly those who orient their lecture materials toward data based research have felt the responsibility to instruct students in data analysis. For example, an article in DEA News, a publication of the Division of Educational Affairs of the American Political Science Association begins boldly: "The teaching of

politics at the undergraduate level increasingly requires an introduction of some sort to quantitative analysis." (Taylor, 1975). The author of this paper concurs with this thrust in the education of political science students.

Recently the American Political Science Association in conjunction with the Inter-University Consortium for Political Research sponsored two workshops to stimulate instruction in quantitative techniques. Funded by a grant from the National Science Foundation, the first workshop was conducted in Ann Arbor, Michigan in the Summer, 1974. The participants of the program produced seven data based instruction packages, five of which are available for general student use for the first time this Fall. Test editions of the packages were distributed to selected campuses during the 1974-1975 academic year. The packages which are designed for Introductory American Government courses have been publicized under the general title SETUPS (Supplementary Empirical Teaching Units in Political Science). A second workshop was held during the Summer, 1975 to produce SETUPS for Introductory Comparative Politics.

Each SETUPS module consists of a data set, an instructor's manual, and a student manual. Generally the manuals have a review of the literature section with bibliography pertaining to a spe-

cific topic in a typical introductory course, (e.g., Political Socialization, Voting Behavior, Public Policy),a methodology section to introduce students to basic concepts of data analysis, and exercises to be completed with the computer. Data sets are also provided with the module.

The instructors' manual gives general instructions about the completion of each exercise using SPSS, OSIRIS, or any other software package. It is possible to use most of the packages with only a Counter-Sorter. A more detailed description of the SETUPS material is available elsewhere.[1]

The SETUPS modules were designed with the following educational objectives:

(1) To teach a substantive body of knowledge in the introductory American Government Course.

(2) To introduce students to the basic methods of data analysis.

(3) To teach elementary techniques of computer usage.

Clearly the long range objective of the SETUPS program is similar to other packages which claim to "Make Fearful Students Enthusiastic About Political Analysis." (Taylor, 1975).

Much of the recent development of CRI[2] materials at the undergraduate level would seem to be the result of instructional success at the primary and secondary education level. The educator quoted at the beginning of

this paper represents a minority report of the research on CRI materials. A recent article in Educational Technology summarized ten major studies in computer related instruction. The authors of the article conclude that "the effectiveness of CAI over traditional instruction seems to be a reasonably well-established fact in drill and practice for both mathematics and language arts. (Vinsonhaler and Bass, 1972). Other research suggests greater learning and retention, (Grubb and Selfridge, 1964), great student interest, (Cunningham and Fuller, 1973), and higher classroom performance among lower aptitude students, (Coulson et al., 1962) with computer related instruction materials.

There have also been critiques of the CRI concept. LaVerne W. Miller (1972:55) argues quite convincingly that "many students fear what they call being dehumanized by hardware." This observation is based on the frustration which students often experience when they do not possess the manual skills (e.g., keypunching or typing) required for the analysis. Indeed my own experience suggests that some students become extremely angry and irritated when they receive an "error message" from a machine. Furthermore mathematical aptitude, not always a prerequisite for successful achievement in political science, may be a determinant of CRI performance. (Rieđ, 1973). Other research suggests that CRI may not be effective for preparing students in concept formation. CRI students scored poorly

on topics not specifically covered in the computer package. (Ried, 1973: 72). Though most of the research on CRI is based on primary or secondary students, the conflict over the effectiveness of the teaching materials suggests a need for more research.

RESEARCH DESIGN

During the Fall, 1974 term, we used one of the SETUPS modules in an introductory American Government course at the State University of New York College at Geneseo. A questionnaire was administered to the students before and after the use of the computer related instruction material.

The SETUPS package required the completion of three exercises. Students were instructed in basic computer techniques required by the package. Methodology concepts of data analysis were also discussed in class. On the day each exercise was due, the instructor led a discussion on the substantive implications of the data analysis. The Voting Behavior SETUPS module, which was used by the experimental group, was supplemented with reading from an American Government text.[3] The entire project was conducted during a five week period in which other course related material was also discussed.

The substantive material and the basic concepts of data analysis covered in the SETUPS package were presented to a second introductory

American Government course in lecture format. This control group, however, was not a course normally taught by the experimenter. The students were told that the lectures presented by the experimenter were part of the course requirements. While this procedure does not provide a control group of the type generally required by the classic experimental research design, it does provide a group for comparison.

The research instrument contained attitude and achievement data relevant to the SETUPS module. Specifically student achievement was measured in each of three areas. First to test achievement in the substantive area of voting behavior, students were asked to select several groups which were likely to vote for the Democratic Party. The CRI students had experience in developing and testing hypotheses about group identification with the political parties and the material was covered in class discussion. The control group was told which groups were likely to vote Democratic in a traditional lecture format. The eight groups in the questionnaire were young people, black people, protestants, people from rural areas, white collar workers, union members, poor people, and people with German ancestry. An eight point index was developed by scoring each correct item marked by the students minus each incorrect item marked.

Achievement scores were computed by subtracting the score at t_2 from the score at t_1.

A second index score was computed to measure student achievement in methodological concepts. The experimenter presented a table of data concerning male and female voting behavior for various levels of education. The example was the same example used in lecture for the control group and used in the first exercise for the experimental group. Three multiple choice questions which offered various interpretations of the data were administered.[4] The items were scored one point for each correct answer. The index of scalability for the items at the time of the posttest was .83 and the index of reproducability was .93 . Achievement scores were computed by subtracting the score at t_2 from the score at t_1.

The third area of achievement involved the retention of information about computer techniques. First students were given a multiple choice question asking the number of columns on a computer card. The item was scored as a dichotomous variable.[5] A second indicator was a vocabulary test of words and abbreviations likely to be used by computer users.[6] The eight item scale was scored by subtracting the number of incorrectly marked items from the number of correctly marked items. Achievement scores were computer by subtracting the score at t_2 from the score at t_1.

The students in both the experimental group and the control group were also asked a variety of attitudinal questions which record their "warmth" toward various college and course related items on a

"feeling thermometer." The feeling thermometer is an indicator of the student affect or warmth toward a specific item. The respondent was asked to record his (or her) feeling about each item on a 100 point scale with 100° representing warm, 50° representing neutral, and 0° representing cold. The scale has been widely used by survey researchers in elections and voting behavior studies.[7]

Finally students were asked to furnish demographic data relevant to the educational setting. Sex, college classification, admission test scores, and grade point averages were coded from information supplied by the Office of Institutional Research at the State University of New York College at Geneseo.

Based on previous research on CRI at the primary and secondary school level, we predicted the following differences in the achievement scores for the experimental and control groups:

H_1: There is a significant difference between the experimental and control groups in achievement of the substantive area of political science covered by the SETUPS module.

H_2: There is a significant difference between the experimental and control groups in achievement of methodological concepts covered by the SETUPS module.

H_3: There is a significant difference between the experimental and control groups in achievement of computer techniques covered by the SETUPS module.

Analysis of Variance was used to test the difference between the experimental and control groups.

The attitudinal research on computer related instruction is contradictory. On the one hand some scholars have noted positive orientations of students toward the learning environment with computer

related instruction. Other research has suggested that CRI materials are "dehumanizing" and produce negative orientations. We tested the CRI effects with analysis of variance to see if there was a significant difference in the two groups:

H_4: There is a significant difference between the experimental and control groups in attitude toward the college environment.

A two tailed test of significance was used since the direction of the attitude change (either positively or negatively) could not be predicted from previous research.

RESULTS

There was little evidence to support the first hypothesis about the substantive area of political science covered by the SETUPS module. The control group demonstrated an average change of .05 from t_1 to t_2 while the experimental group showed lower change from t_1 to t_2 (-.07).[8] We defined these changes as achievement scores, but the difference in the two groups can be attributed to chance variation 99.9% of the time.[9] Recalling that this index measured the students achievement in recognizing groups in the Democratic Party coalition, we concluded that there was no significant difference in the performance of computer related instruction and a lecture format as a teaching method for instructing voting behavior.

This conclusion should not go unnoticed. While CRI students did not demonstrate greater achievement, they did not demonstrate

worse achievement either. Some educators may believe that the extra time required to instruct students in computer techniques detracts from the more important substantive material of the course. At a minimum these teachers might believe that the loss of time in substantive lecture presentation would detract from the course material to be covered in class. We find no evidence to reject or support that conjecture. To repeat students who spent class hours learning computer techniques showed no significant difference from students taught in lecture format with regard to their knowledge of voting behavior concepts.

There was evidence to support our second hypothesis. Students using the CRI materials were significantly different from students taught in a lecture format in their methodological achievement. CRI students had an average achievement score of .24 while the control students had average scores of -.35. These differences could be attributed to chance variation only 3.4% of the time.[10] In other words the students ability to interpret contingency tables was significantly increased by the SETUPS module.

Furthermore we covaried several other variables to test the independent effects of sex and student classification (i.e., Freshman, Sophomore, Junior, Senior) on the analysis. In neither case were the independent effects of these characteristics significant nor did they alter the main effects of the experiment. Since previous research

had suggested that aptitude was related to CRI effectiveness, we also adjusted the means of the experimental and control groups for high school standing, cumulative grade point average, and SAT admission scores.[11] These variables did not change the significance of the results. In other words good students and poor students measured by standardized admission scores and previous education performance demonstrated the same advances in methodological achievement. Finally we adjusted the student means in methodology concepts for their attitude toward the computer.[12] Again the differences between the experimental and control groups were unchanged.

There was also evidence to support the third hypothesis. With the simple information test asking how many columns on a computer card, the CRI students demonstrated a significant difference than the lecture taught students. A value of F=3.15 with 54 degrees of freedom has a significance level of .035. Students using SETUPS learned the number of columns on a computer card significantly better than students who learned the information in lecture.

This finding suggests an important maxim in education. The number of columns on a computer card was a relevant piece of information for students who performed computer tasks. The SETUPS package required students to keypunch a small number of computer cards. Thus they were forced to handle the cards and become familiar with their physical appearance. Even though a computer card was

handed out to students in the lecture format class, the number of columns on a card remained an isolated fact. The physical appearance of a computer card was simply another information bit in the barrage of lecture material presented in class. Indeed achievement in computer techniques seems best learned by those students who were required to perform computer exercises.

This discussion has additional support in our second indicator of computer techniques achievement. Though the experimenter was careful to use the vocabulary of a computer user and to explain all the computer terms on the test instrument, CRI students demonstrated a significantly higher achievement in computer techniques than did lecture taught students. The mean score of the control group was -.26 while the mean score of the experimental group was .40. These differences are significant at the .035 level. When the results were adjusted for sex, student classification, high school standing, cumulative grade point average, SAT admission scores, and attitude toward the computer, the main effects of the experimental design were not altered.

The fourth hypothesis tested several indicators of attitude toward the college environment. We predicted that there would be a significant difference between the control group and the experimental group with several attitudes. To test this proposition a feeling thermometer was used to show warmth toward objects and concepts in

the college environment. Specifically we asked students to record their feeling toward higher education, college, liberal arts, Geneseo--New York (the village in which the College is located), State University College at Geneseo, political science, Introduction to American Government, and the computer. Feelings were recorded before and after the SETUPS material was presented. Attitude change was measured by subtracting the feeling at t_1 from the feeling at t_2.

Table I shows clearly that there was very little attitude change

TABLE I GOES HERE

for the students in either class. The values in column I of Table I are the average attitude change scores for the students in both classes. That all values are relatively close to 0.00 suggests very little change resulting from the course experience. However the change which is recorded was in the positive (warmer) direction for all items except "higher education."

To test the main effects of the experimental design, a t-test of the two groups was computed. The values of T with 54 degrees of freedom were not significant for any of the items at the .05 level. Thus we were not able to detect any significant attitude change with the wide variety of attitude items.

DISCUSSION AND CONCLUSIONS

The results of this study provide no definitive answers for the educator seeking new techniques for instruction. However we believe

TABLE I: Analysis of Variance Statistics for Student Attitudes Toward the College Environment

	$\bar{X}$ (All Students)	T-Value (54 Degrees of Freedom)	2-Tailed Probability
HIGHER EDUCATION	-0.40	-0.41	.681
COLLEGE	1.16	-0.07	.947
LIBERAL ARTS	3.02	1.35	.182
GENESEO, N.Y.	1.11	-0.99	.324
SUNY-GENESEO	2.45	-1.07	.287
POLITICAL SCIENCE	2.52	-0.60	.549
INTRODUCTION TO AMERICAN GOVERNMENT	3.62	-1.36	.179
COMPUTER	1.191	-0.78	.439

some of the objectives of computer related instruction have been met with the SETUPS materials.

On the positive side we found evidence to support the proposition that students learn methodological concepts and computer techniques by participating in computer related instruction. The students who used the SETUPS module showed significantly greater achievement in these two areas of instruction.

The importance of this conclusion must be left to the individual instructor. We believe that quantitative analysis has become so central to the discipline of political science that undergraduate students should become familiar with these concepts. The extreme case is made by a co-author of the Voting Behavior module who states that he does not care if his students learn any political science as long as they understand political analysis. We are not prepared to make this distinction. As such we recognize basic methodology and computer techniques as an integral part of an Introductory American Government course.

Secondly there was no support for the proposition that students learn political science subjects better with computer related instruction. Lecture appears to be an equally effective technique for teaching the substance of politics--or at least voting behavior.

Again this conclusion is not disconcerting for the teacher who wishes to use CRI materials. There was no significant difference

between the CRI students and the lecture taught students. Thus it would appear that nothing is lost by spending the time teaching methodology and computer techniques. For those who believe that methodology and computer techniques are an important facet of political science, this finding should be rather satisfying. Clearly there was no evidence to support the conventional lecture as a superior technique.

Finally student attitudes toward the college environment were not significantly changed by CRI. This conclusion has implications for today's system of higher education. To be sure we were rather disappointed with the results.

With shrinking enrollments and budgets in higher education, it is the realist rather than the cynic who understands that students are consumers. It is perhaps the irony of higher education that a period of student apathy has produced real power for most college students. Department budgets, curriculum development, personnel recruitment, tenure policy, and a whole array of administrative decisions are increasingly being made with student enrollments in mind. Thus student attitudes are an ever increasing consideration to those who are interested in seeing enrollments grow. That we were unable to detect any significant attitude change among students, suggests that CRI will not become the panacea for political science departments.

On the more optimistic side attitude changes were almost all positive. Students rated their course, political science, the college, and the community higher after attending several weeks of ciasses. Perhaps we are doing something right. CRI is most probably a portion of the feelings students have about their college environment. At least one person has noticed an increased FTE with CRI.

FOOTNOTES

* The author wishes to acknowledge Jeff James who allowed his class to participate in this experiment, Tom Curtin who spent countless hours preparing the data, JoAnn Mayo who provided information about standardized admission scores, the Office of Institutional Research at State University of New York College at Geneseo which provided admission scores and grade point average for the students, and Laurie Sherner who typed the manuscript with an unreasonable deadline. I also wish to thank Mark Levine who conducted several computer runs when our SPSS package proved to be outdated. Finally my special thanks goes to the students in both Professor James's and my introductory American Government classes without whom this project would not have been possible.

[1] For example, see DEA News supplement, No. 4 and No. 5.

[2] CRI is an abbreviation for "Computer Related Instruction" and is used throughout this paper to mean educational materials which rely on the computer at some time in the instruction of students. Primary and secondary educators are perhaps more familiar with the abbreviation for "Computer Assisted Instruction." CAI refers to rote instruction which is programmed to drill students in areas producing the most errors. We use the term CRI throughout this paper except for direct quotes since CRI is the more familiar term used by political scientists.

[3]The required text for the course was Kenneth Prewitt and Sidney Verba, An Introduction to American Government (New York: Harper & Row, Publishers, 1974).

The SETUPS module for the course was Bruce D. Bowen, C. Anthony Broh, and Charles L. Prysby, Voting Behavior: The 1972 Election, Test Edition (Washington: The American Political Science Association, 1974).

[4]In a recent public opinion survey of the United States men and women with various degrees of education were asked whether or not they voted. The results of the survey were as follows:

	People with Low Education		People with Medium Education		People with High Education	
	Male	Female	Male	Female	Male	Female
Voted	67%	50%	74%	68%	84%	89%
Didn't Vote	33%	50%	26%	32%	16%	11%

Which of the following statements is true about the survey?

_____Men voted more than women

_____Women voted more than men

_____High educated people voted more than low educated people

_____None of the above

Which of the following statements is true about the survey?

_____Males vote more than females only if they have low education

_____Males vote more than females only if they have education

_____Females vote more than males only if they have high education

_____None of the above

Which of the following statements is true about the survey?

_____Education is not important in predicting who did vote and who did not vote

_____Sex is related to education for males and females

_____The relationship between sex and voting must be specified by education level

_____All of the above

[5]The actual wording of the question was "How many columns are there on a computer card? (A) 80 (B) 88 (C) 100 (D) 55 (E) I don't know"

[6]The eight items in the index were Turnaround, Disk, Stuff, Kick, SPSS, Nozzle, CCCD, Punch.

[7]The Feeling Thermometer first appeared in CPS Studies in 1964 and has been used every election year since then.

[8]The scores presented here are category mean deviations from the grand mean. Thus a positive score indicates that this group did better than average; a negative score indicates that this group did worse than average.

[9]F= .093 with 54 degrees of freedom has a significance value of .999.

[10] F = 4.597 with 53 degrees of freedom has a significance level of .034. Eta = .28.

[11]SAT admission scores were the combined verbal and math scores for the scholastic aptitude test. To minimize missing data, we converted New York State Regent Scholarship Examination scores to an SAT equivalent according to an equivalency formula developed by the Admissions Office of the State University of New York College at Geneseo. Students

who had not taken the SAT were given RSE equivalency scores.

[12]Attitude toward the computer was measured by scores on a feeling thermometer. Student attitudes toward several objects and concepts are discussed below.

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